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Title: Los Alamos National Laboratory Maintenance Management Naval Reactors Site Visit

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Intended for: Presentations and other Information requested for the Naval Reactors (NR) and Naval Nuclear Laboratory (NNL) Team as a result of a benchmarking visit July 2017.

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Los Alamos National Laboratory Maintenance Management

Naval Reactors Site Visit

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July 18, 2017

Operated by Los Alamos National Security, LLC for the U.S. Department of Energy's NNSA

Topics Requested

- Observe how LLNL and LANL perform corrective and preventative maintenance work, including scoping, prioritization, planning, engineering, scheduling, execution, subcontracting and data entry for reporting.
- Understand how CMMS (LANL uses Asset Suites) is used and how it is integrated into other management tools like BUILDER to capture data.
- Understand the metrics used to monitor performance.
- Understand who performs each necessary role from corrective maintenance requests and preventive maintenance decisions through completion of work, including the necessary staffing, skills, and qualifications.
- Understand how NNSA M&O partners deal with emergent work, in terms of changes to planned, resource allocation (skills), and funding.

Los Alamos Maintenance at a Glance

- **180 professionals organized into 10 Groups (Work Control; Maintenance Programs; Central Execution; and 7 Deployed Maintenance Groups)**
- **ADPM went over 1,000 craft for the first time on June 6, 2017**
- **Many ex-Navy Nukes**
- **What we do**
  - Maintain an installation ~40 square miles
  - Maintenance of Utilities and Nuclear and Non-Nuclear facilities (~1200 buildings with 8.2M ft^2)
  - Execute ~3000 - 4000 evolutions/month
  - Approximately 66% are moderate/high hazard work orders
  - Manage ~$150M/year budget

MSS at LANL is a "heavy maintenance" division. Majority of work is self-performed and moderate/high hazard

Preventive Maintenance

- **Strength of our program**
  - Average 1,400 PMs/Mo
  - >98% completed as scheduled.
    - We do not count 25% Grace Period in that calculation
    - >98% for the past 2 years.
  - There is a formal PM deferral process
    - ML-1, 2, 3 deferred by Cognizant System Engineer. ML-4 deferred by Maintenance Manager
    - Technical justification is required

FOD #	FOD	Previous Score	PMs Due	PMs Comp	% On Time
1	TA-55	100%	149	149	100%
2	CMR	100%	45	45	100%
3	WFO	98.9%	249	248	99.6%
4	LANSCE	100%	93	93	100%
5	EWMO	96.8%	80	78	97.5%
6	STO	100%	268	266	99.3%
7/8	UI	100%	428	428	100%
10	RLW/RLUOB	100%	63	63	100%
Overall		99.6%	1375	1370	99.6%

Performance Measure	
Green	>=98%
Yellow	>=95to<98%
Red	<95%

Definition

This metric measures how many scheduled PMs were completed by their original schedule date.

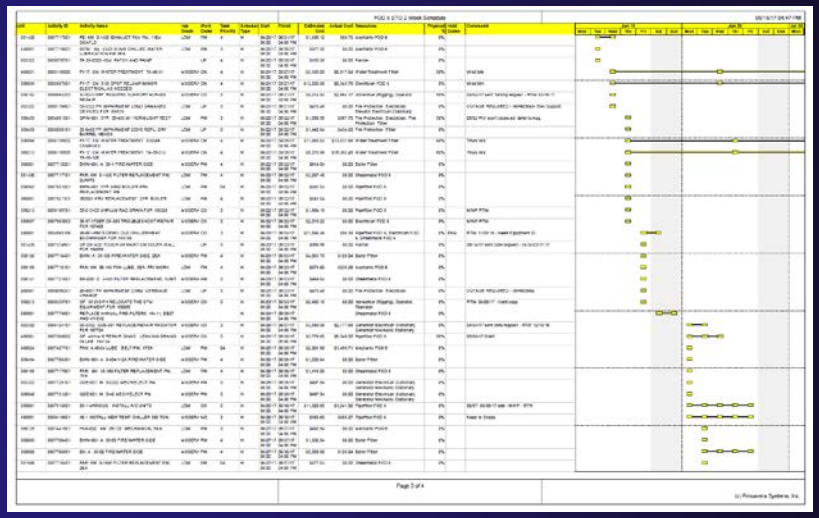
PMs have been reduced to what is required by code. Making PMs sacred has unintended consequences

Scoping and Planning

- **We have a low hazard Minor Maintenance process**
  - Activities have been identified for all 13 collective bargaining units
  - Joint Hazard Analysis Manual covers each task (VPP Best Practice)
  - Pre-job briefing required for all work
- **All other work is planned as moderate/high hazard. Requires**
  - Scoping walk downs with the craft
  - Table top JHA with SMEs
- **Work orders planned in Asset Suites (our CMMS)**
  - Engineering support is requested via the Engineering Service Request system and tied to the work order in CMMS
- **Maintenance Contractors follow the same process**

Maintenance Scheduling

- **Scheduling is done in Primavera P6**
  - FOD, Utilities, Central Shop and STR P6 schedules are integrated
- **We use a Target Week (T-Week) process recommended in INPO-AP-928**
  - T Week Meetings at each FOD and for Central Shops
  - Operations sets the priority
  - Emergent issues that require breaking schedule are facilitated by maintenance managers
  - Review schedule “by exception basis”.
  - Issues are identified for resolution
  - PM work is reviewed to ensure it is properly scheduled and bundled for the target work week
  - Scope is frozen the Thursday before the work week



Maintenance Scheduling

- **Schedule compliance is measured weekly with >80% acceptance criteria.**
- **Maintenance scheduling going forward**
  - Need better tools/expectations for T Week stability (i.e. how much work in a target week T-10 actually gets worked at T-0
  - Future expectations include scope freeze at T-2

POTW Schedule Compliance

FOD #	FOD (RDL)	Previous Month Compliance Average	Current Month Compliance Average
1	TA-55	90.8%	89.3%
2	CMR	93.6%	83.6%
3	WFO	98.6%	99.5%
4	LANSCE	85.5%	90.3%
5	EWMO	73.6%	89.7%
6	STO	97.3%	97.7%
8	UI	98.4%	99.6%
10	RLW/RLUOB	83.3%	89.0%
Overall Status		90.1%	92.3%

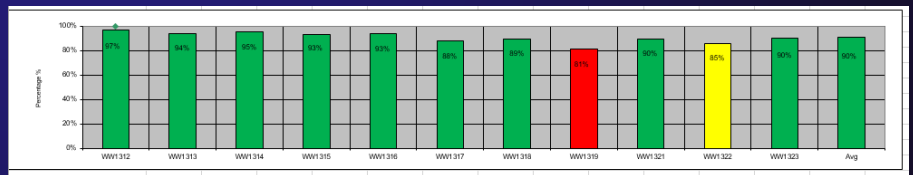
Performance Measure		Definition
Green	>80%	This metric measures POW schedule compliance. The denominator is all work orders that were part of the scope freeze on the Thursday of the previous week. The numerator is how many of those scheduled work orders were completed. Emergent work and add-ons are **not** counted as completions.
Yellow	>70 to 80%	
Red	<70%	

Analysis

All FODs were above the 80% threshold.

Actions

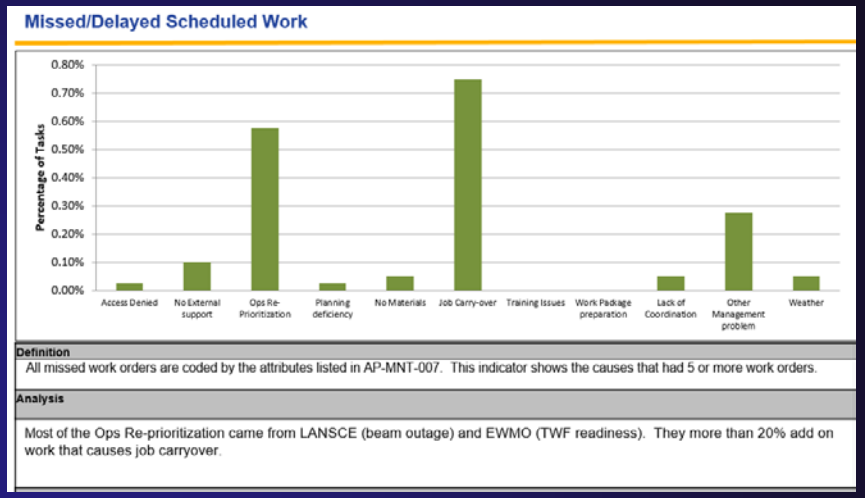
None

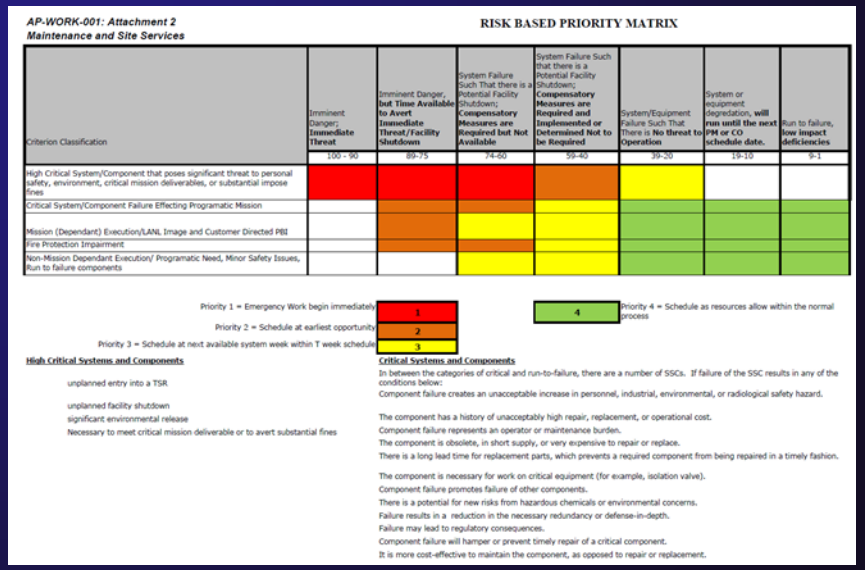


Green Goal		WW1312	WW1313	WW1314	WW1315	WW1316	WW1317	WW1318	WW1319	WW1321	WW1322	WW1323	Avg
T-11 to T-10 Stability	80%	98%	96%	98%	97%	93%	89%	88%	37%	78%	70%	98%	86%
T-8 to T-5 Stability	80%	98%	95%	97%	96%	100%	81%	89%	84%	91%	88%	87%	91%
T-4 Planning Complete	100%	100%	99%	92%	92%	100%	89%	94%	94%	95%	94%	90%	94%
T-4 to T-1 Stability	90%	93%	84%	94%	89%	87%	92%	93%	99%	99%	98%	84%	92%
Weekly Adherence	92%	94%	95%	94%	92%	87%	88%	81%	91%	85%	77%	90%	89%
Weekly Average	88%	97%	94%	95%	93%	93%	88%	89%	81%	90%	85%	90%	90%
Performance Indicator Colors			Green			White			Yellow			Red	

Maintenance Scheduling & Priorities

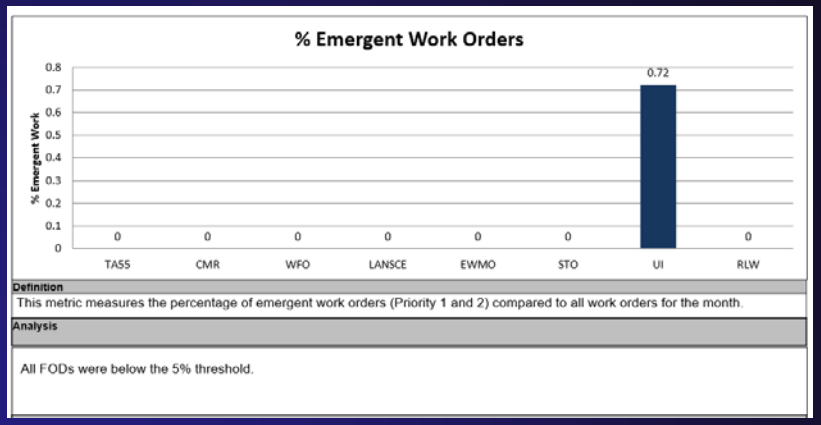
- **We code each missed work order and review monthly.**
- **We use a 4 level risk based priority system**
  - Based on impact of the failure
  - Takes the emotion out of assigning the priority code
  - FODs must arrange swap of resources if they break the schedule

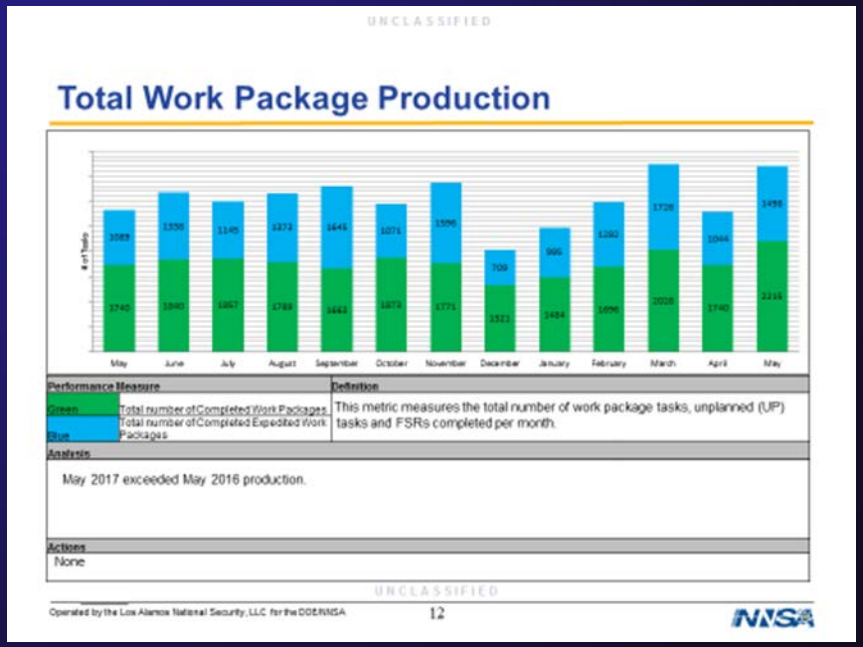




Work Execution

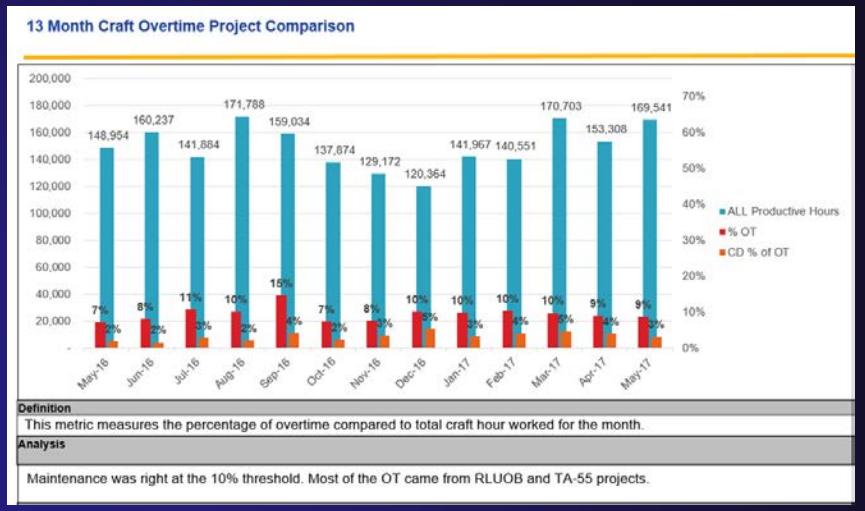
- **Emergent work is tracked**
  - Industry standard is <5%
- **Total Maintenance Production is measured and reported monthly**
  - Comparison to same month in previous year
  - Replacement-in-Kind, Mobile Work Packages, and Minor Maintenance efforts to increase productivity
    - ~33% minor maintenance (aka tool pouch, skill of the craft.)

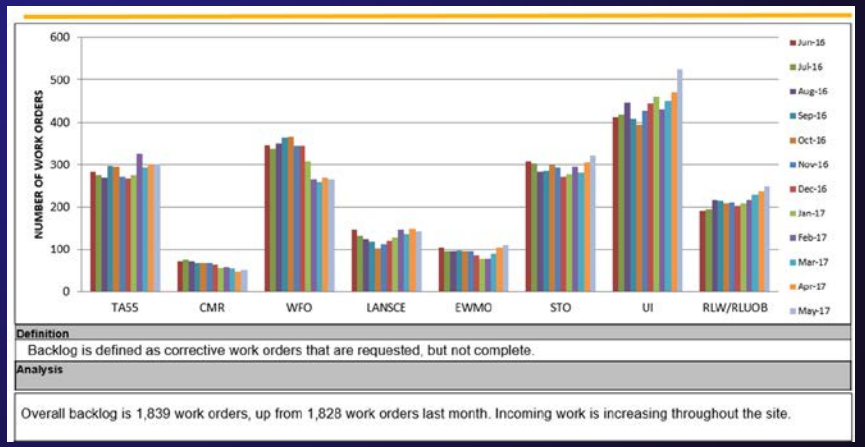




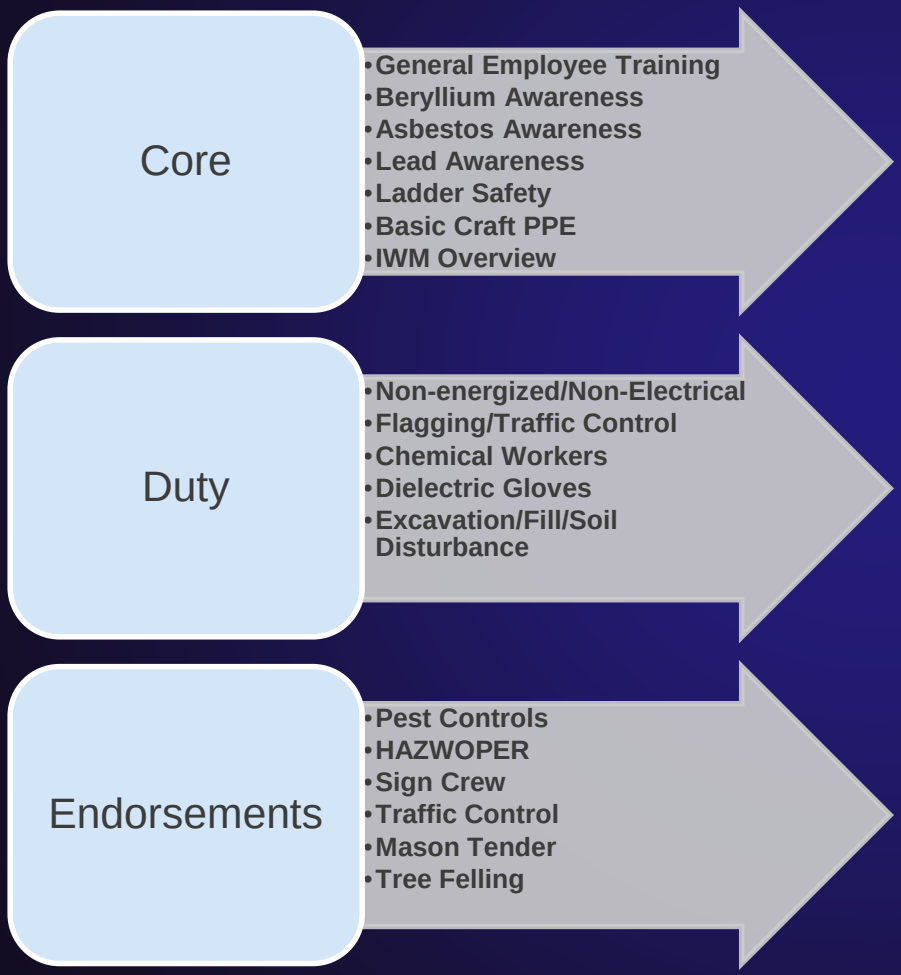
Work Execution

- **We monitor Overtime monthly**
  - Goal is to stay below 10%
  - Failing despite pushing record numbers of craft
- **We also monitor backlog**
  - Current backlog is at 1839 corrective work orders and rising
  - Approaching 9 crew weeks
    - DOE Handbook recommends maintaining between 4-8 crew weeks





Maintenance Training
(Laborer used as example)



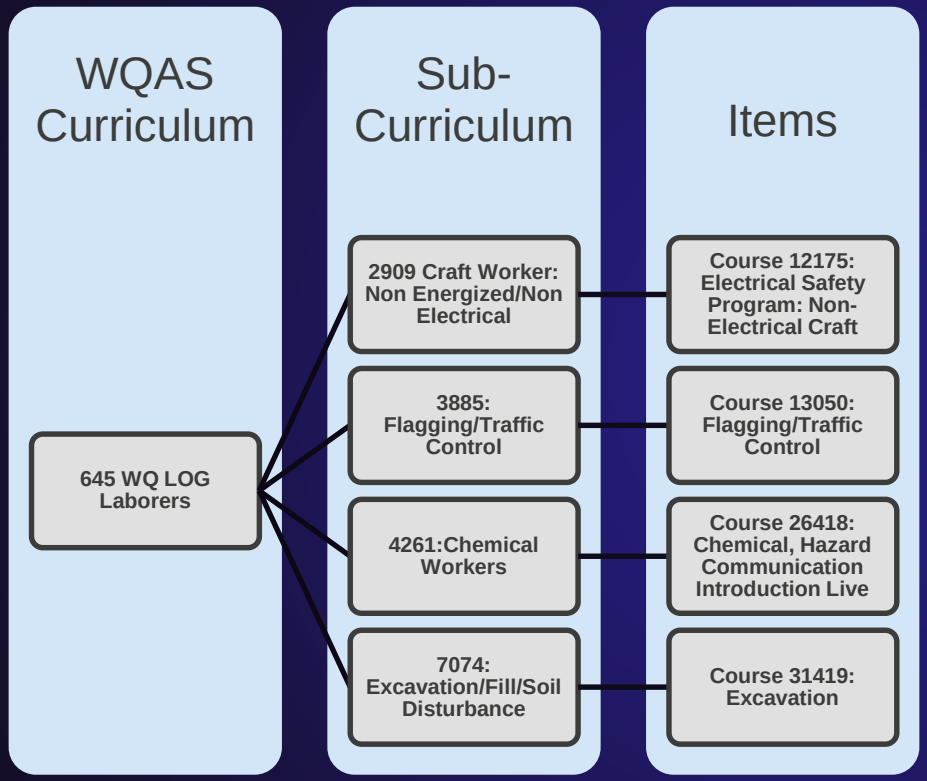
Every worker is assigned Core, Duty, and Endorsements

- **Core requirements are what is expected from the worker straight off the street.**
- **Duty requirements are minimum requirements to work is a particular work area: Example is for Laborer. Other examples are Carpenter, Electrician, Ironworker, Teamster…etc.**
- **Endorsements are specialized skills**

Maintenance & Logistics have a very robust qualification program

Maintenance Training
(laborer used as example)

Training Plans



- Curriculum like Non Energized/ Non Electrical Worker become sub-curriculum when in a WQAS
- Items can be courses, required readings, Non-Train, or On-the Job trainings
- With ~1000 craft, training is a herculean task
  - ~45,000 course events/year
  - Workforce turn over
  - < 1/3 craft have cryptocards

Maintenance use WQAS for all craft and manager training.

Maintenance Training

- First line of defense is to keep every individual fully qualified
  - Individuals assigned to WQAS
  - Items established in UTrain
  - UTrain generates alerts for Managers & Supervisors
    - Upcoming, Overdue or Expired Training Notifications
    - Supervisor Registration Notifications
    - Supervisor Withdrawal Notifications
- Training Requirements are included in the IWD
- Person-in-Charge (PIC) checks training required against the worker qualifications

Maintenance averages >98% trained at any given moment

Mobile Work Packages

- **Mobile Work Package (MWP)**
  - Converts 1970s paper based procedures into an all-electronic process
  - Allows personnel to plan, approve, perform, and archive work orders using only desktop and tablet computers
  - Improves work force efficiency & productivity
  - Increases data quality and enhances records management
  - Lowers operational cost

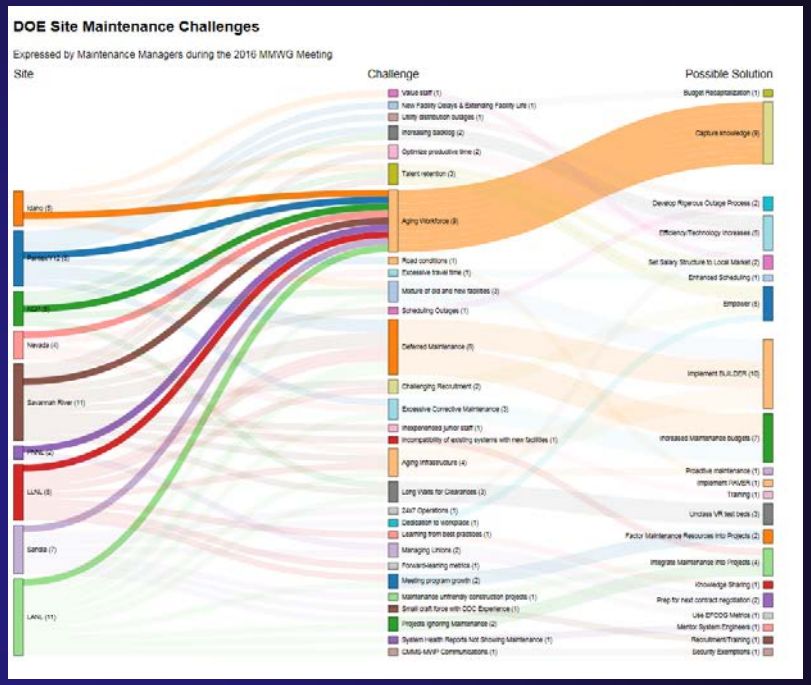
  https://www.youtube.com/watch?v=EEYq-AuGvnI&feature=youtu.be
- **Current Status**
  - Successfully performed >17,000 tasks
  - Exceeded 1,500 work order tasks per month
  - Received NA-50 Excellence Award for MWP
- **Future**
  - Knowledge capture/transfer via video
  - Computer Based Procedures
  - Linking work packages to other data bases: Training, MSDS

Successfully deployed to all FODs and Central Maintenance. >17,000 evolutions accomplished via MWP. The potential for future applications on MWP is only limited by one's imagination.

Maintenance Technology Initiatives

- **We started Maintenance Management Workshops for all NNSA sites 3 years ago**
  - Workshop identified Knowledge Retention as the biggest concern
  - The Maintenance Technology Working Group recommended video work steps as potential solution
- **Current Status**
  - Completed several videos for jobs have knowledge based traps that only the senior craft really know (where to heat a vessel, unique voltage checks etc.)
  - Plan is to link these videos to Mobile Work Package for use in Pre-Jobs or as a job site reference (just like looking up how to videos on YouTube)

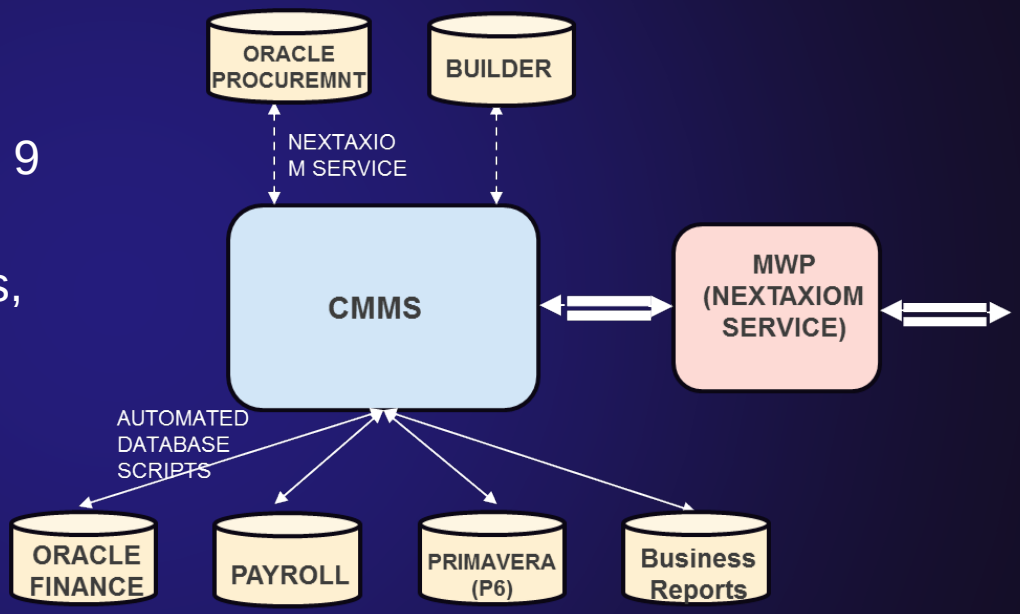
https://www.youtube.com/watch?v=Kn33FJGJPQA&feature=youtu.be



We are working with NA 50 to develop video work steps on complicated or infrequently performed work evolutions. This should not only help with knowledge retention as our work force ages but have an immediate impact of the safe execution of work in the field.

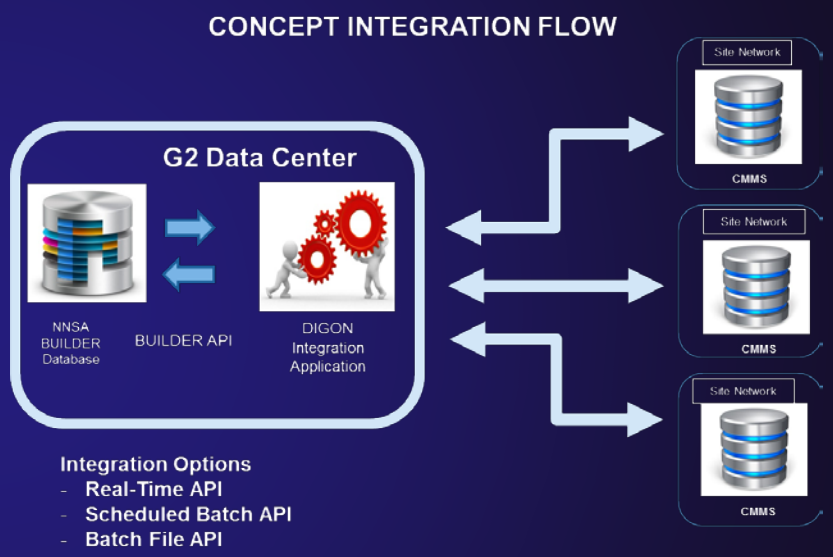
Computerized Maintenance Management System (CMMS)

- **We use Asset Suites as our CMMS (Owned by ABB)**
  - Currently on Version 7.0.2
  - Currently upgrading to Version 9
  - Over 1,000 licensed users including Planners, Schedulers, Engineers, Managers and Supervisors
  - Over 140,000 pieces of equipment in the MEL
- **MWP and CMMS are integrated**
- **Using upgrade to align CMMS with BUILDER and to increase functionality**



BUILDER CMMS INTEGRATION

- NA 50 has selected BUILDER as the asset management platform for NNSA
- Current Status
  - 100% complete with all our assessments (Atkins Nuclear Solutions)
  - The detailed work now begins to understand the overall sustainment of BUILDER as it relates to DOE 430.1C and the Supplemental Directive
- Future
  - In 2 Years, NNSA will using BUILDER as a decision making tool for budgets and will be the data base for DM



BUILDER CMMS INTEGRATION

- **INTEGRATION**
  - **Lessons learned from DoD was that BUILDER data quickly went out of date**
  - **LANL is working with NA-50 to define functional specifications for Asset Suites to keep life cycle information current (based on Wiebull formula)**
  - **Goal is to have all data that effects the component life cycle automatically fed to BUILDER**

$$f(T) = \frac{\beta}{\eta}\left(\frac{T-\gamma}{\eta}\right)^{\beta-1} e^{-\left(\frac{T-\gamma}{\eta}\right)^{\beta}}$$

- **BUILDER CMMS Integration Pilots**
  - Two (2) CMMS programs selected
    - Sandia (MAXIMO): Mapped all assets in MAXIMO per Uniformat II
    - Los Alamos (Asset Suite): Previous integration effort between Asset Suite and other site level programs
  - Pilot Integration Effort
    - Initial implementation of the ‘Integration Tool’
    - Code Update, Testing, Limited Deployment to Production, Site-wide Deployment

Questions